DEVELOPING QUALITY AND PERFORMANCE OF CONSTRUCTION USING 3D MODEL IN BUILDING INFORMATION MODELLING

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I/We* hereby declare that I/We* have checked this thesis/project* and in my/our* opinion, this thesis/project* is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Tujuan kajian ini adalah untuk meneroka potensi teknologi BIM (Building Information Modeling) yang digunakan untuk pengurusan dan penyelenggaraan prosedur pembinaan bangunan yang lebih khusus. Ia memberi tumpuan kepada konsep objek dan didedikasikan untuk penerangan 3D (tiga dimensi) persekitaran yang dibina. Ia membolehkan penerangan dan perwakilannya secara holistik, dengan menerangkan objek yang dibina melalui skala lebih atau kurang terperinci, dan kompleks, jika satu menggabungkan satu set data geometri dan bukan geometri dengan kemungkinan parametrization objek. Selain itu, kajian ini menyiasat proses penyelarasan perdagangan model BIM 3D untuk cabaran dan masalah melalui pendekatan kajian kes dan menawarkan wawasan untuk penambahbaikan berterusan.

ABSTRACT

The purpose of this study is to explore the potential of BIM (Building Information Modeling) technology used for the management and maintenance of more specialized building construction procedures. It focuses on the concept of objects and is dedicated to the 3D (three-dimensional) description of the built environment. It allows its description and representation holistically, by describing objects constructed over more or less detail scale, and complex, if one combines a set of geometric and non-geometric data with the possibility of parametrization of the object. Additionally, this study investigates the BIM 3D model trading alignment process for challenges and problems through a case study approach and offers insights for continuous improvement.

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LIST OF SYMBOLS

BIM	Building Information Modeling
AEC	Architectural, Engineering and Construction
CAD	Computer-Aided Design
2D	Two-Dimensional
3D	Three-Dimensional
FM	Facility Mnagement
PM	Project Management
KK4	Kolej Kediaman 4
UMP	Universiti Malaysia Pahang
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PDF	Portable Document Format

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Building Information Modeling (BIM) is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle, defined as existing from earliest conception to demolition. BIM is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct and manage buildings and infrastructures (Autodesk, 2018). It is a process for creating and managing all the information on a project before, during and after construction.

Besides that, BIM is a platform to share knowledge and communicate with project participants. Architects, contractors and engineers use the software to visualize, design and coordinate the construction of a building end to end (G2 Crowd, 2018). BIM software is similar to CAD but the difference is that all the tools are for designing a building. Both 2D and 3D modelling tools are often included in BIM, which allows for creating construction documents and visualization. The output of this process is the Building Information Model, the high-quality 3D renderings and digital description of every aspect of the built asset.

This project intends to address the topic of developing quality and performance of construction using the 3D model in BIM within an organization which include visualization, 3D coordination and record model in detail. BIM tools were further analyzed by developing a prototype 3D model. The research concluded that although BIM tools do pose some shortcoming such as interoperability issues, the use of BIM is very beneficial to the construction managers.

Figure 1.1 The Process of Building Information Modelling

1.2 Background of Study

Participants in the building process are constantly challenged to deliver successful projects despite tight budgets, limited manpower, accelerated schedules, as well as problems that regarding the issue of waste, which is happening due to the fragmented nature of the AEC industry (RCS, 2014; Man and Machine, 2014). The AEC industry has long sought to adapt techniques to increase productivity and quality, decrease project cost, reduce delivery time and eliminate waste which one of these techniques is BIM. Traditionally, architectural design, structural analysis and construction management are three separate steps with distinct objectives in building engineering activities. With the prevalence of information technologies in the building industry, the combination of design and construction activities can be achieved through the integration of BIM and 3D technology (Zhenong *et al*., 2008).

BIM is an inevitable development from 3D CAD (Malleson, 2013). BIM represents the development and the use of the computer generated n-dimensional (n-D) model to stimulate the design, construction and operation of the facility. It is the process and practice of virtual design and construction throughout its lifecycle (AGC, 2005; Lorch, 2012). The key benefits of BIM are its accurate geometrical representation of the parts of a building in an integrated data environment (CRC Construction Innovation,

2007). The use of BIM can increase the value of a building, shorten the project duration, provide reliable cost estimates, produce market-ready facilities and optimize facility management and maintenance (Eastman *et al*., 2011).

On the other hand, the realization of the benefits of BIM is contingent upon a proper implementation of 3D BIM at an organisational level and its integration at the industry level (Khosrowshahi and Arayici, 2012). In general, the barriers to BIM adoption in the AEC industry may be knowledge barriers, technical barriers, process barriers, managerial barriers, legal barriers, cultural barriers, as well as barriers to education and training (Fischer and Kunz, 2004)

1.3 Problem Statement

Implementing BIM into a company construction will cause some changes. Employees need to be able to work with different software such as Revit, ArchiCAD or Navisworks. Training enables them to use these software programmes. This does not mean they are fully capable to use all the facilities BIM offers to its users. BIM is not just software; it is a process and software but they to implement a new way of thinking BIM entails (Hardin, 2009). This new way of thinking should lead to more collaboration, effectively deploying and utilizing data multidisciplinary and throughout the building lifecycle (Adamu, 2014). Most of the people involved in the construction project are lack of communication and less interaction among the project teams directly contributes the problem. The earlier the changes are identified, the lesser impact it will have on the project. Besides that, conflicts over project changes can be minimized when the problem is found at the earlier phase of the project.

The problem with the traditional/conventional method is that the documents produced are same as manual and did not save the building design and construction industry from being inefficient. CAD systems did nothing to reduce errors and wastages which basically arise due to coordination problems. With the introduction of 3D modelling techniques, advanced definition and complex surfacing tools were added. It is clear that 3D BIM model could improve quality and performance in the construction industry.

Usually, during the design stage, planners and architects work independently with little input and lack of communication with each other (Granroth, 2011). Due to

REFERENCES

Abdul-Rahman, H., Thompson, P.A. & Whyte, I.L. (1996). Capturing the Cost of Non-Conformance on Construction Sites: an Application of the Quality Cost Matrix. *International Journal of Quality & Reliability Management* 13 (1), pp. 48–60.

Atkinson, R. (1999). Project Management: Cost, Time and Quality, Two Best Guesses and A Phenomenon, It's Time to Accept Other Success Criteria. *International Journal of Project Management*. 17(6), pp. 337-342.

Autodesk (2008). Autodesk Inc. Improving Building Industry Results through Integrated Project Delivery and Building Information Modeling. *White Paper,* Retrieved August 23, 2012 from online at http://images.autodesk.com/adsk/files/bim_and_ipd_whitepaper.pdf

Azhar, S., Nadeem, A., Mok, J. Y. & Leung, B. H. (2008). Building Information Modeling (BIM): A new paradigm for visual interactive modeling and simulation for construction projects. In *Proceeding First International Conference on Construction in Developing Countries*, pp. 435-446.

Azhar, S. (2011). Building information modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry. Leadership and Management in Engineering, 11(3), 241-252.

Chan, W.M.C. & Kumaraswamy, M.M. (2002). Compressing Construction Durations: Lessons Learned From Hong Kong Building Project. I*nternational Journal of Project Management,* 20 (1), pp. 23-35.

Eastman, Chuck, Paul Tiecholz, Rafael Sacks, and Kathleen Liston. *BIM Handbook.* New Jersey: John Wiley & Sons, 2018. Print.

Eastman, C., Teicholz, P., Sacks, R. & Liston, K. (2011). BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. John Wiley & Sons, Hoboken, NJ.

Kerzner, H. (2006). Project Management a system Approach to Planning Scheduling and Controlling (9th ed.). New York: John Willey & Sons.

Minato, T. (2003). Design Documents Quality In The Japanese Construction Industry: Factors Influencing And Impacts On Construction Process. I*nternational Journal of Project Management,* 21 (7), pp. 537-546.

Qian Chen, Ph.D. , Hongsen Shi, Alex Belkofer, (2017) Challenges in the Building Information Modeling (BIM)/3D Trade Coordination Process

Salman Azhar, Ph.D., A.M.ASCE (2011), Building Information Modeling (BIM): Trends, Benefits, Risks, and Challenges for the AEC Industry

Samuelson, O. (2008). The IT-barometer – a decade's development of IT use in the Swedish construction sector, ITcon Vol. 13, pp. 1-19, Retreived May 15, 2012 from http://www.itcon.org/2008/1.

Saputra, Y.A. & Ladamay, O.S.A. (2011). Project reliability: probability of a project meets [sic] its quality-cost-time target under uncertainty. *International Journal of Electronic Business Management,* 9 (3), pp. 220-230.

Raymond, L. & Bergeron, F. (2008). Project management information systems: an empirical research of their impact on project managers and project success. *International Journal of Project Management,* 26, pp. 213–220.

The challenges that BIM creates, (2018), retrieved from https://www.aconex.com/what-is-BIM

Radford, A. D. & Gero, J. S. (1988). *Design by Optimization in Architecture, Building and Construction.* New York: Van Nostrand Reinhold.

Walker, A. (2007). Project Management in Construction. 5th and. Oxford: Blackwell.